ISSN: 2536-7153 SJMLS

Sokoto Journal of Medical Laboratory Science 2023; 8(4): 100 - 104

SJMLS - 8(4) - 012

Formulation and Antimicrobial Activities of the Selected Cosmetic Products from *Hura crepitans* Seeds Oil

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https://dx.doi.org/10.4314/sokjmls.v8i4.12

Abstract
The cosmetics sector of the economy is significantly increasing very quickly. The lifestyle of today, which is based on technological advancements and awareness of the effects of various factors on human health and fitness, is adapted to consumer demands. This, therefore, has attracted the attention of the cosmetics manufacturer to include natural ingredients that are environmentally friendly and which also have positive health effects. The durability and safety of cosmetics are ensured by using substances with antimicrobial activity as ingredients. The aim of this work is to formulate selected cosmetics products and their antimicrobial activity. The oil extracted from *Hura crepitans* seeds (as published in our previous work) was used for the formulation of three cosmetic products namely skin cream, hair, cream, and bar soap for domestic use. The antimicrobial activities of the formulated cosmetic products were determined using the agar well diffusion method. Furthermore, the physical properties such as colour, fragrance, and pH of the formulated products were determined using a pH meter and by physical means. The antimicrobial results of the three formulated products show that these products exhibited significant antimicrobial activities with hair cream having the most consistent concentration-dependent inhibition (22 to 9 mm) when compared with the standard drug Ofloxacin used. This result has further suggested their safe domestic usage. In conclusion, the findings of this research study validate the potential of *H. crepitans* seeds oil as an active ingredient in the cosmetic industry. Thus, recommended that there is a need for acute dermal toxicity studies to be carried out on the formulated products to further assess their safety.

Keywords: Antimicrobial, Cosmetic, *Hura crepitans* oil, Formulation

Introduction
Consumer awareness of the damaging effects of industrial development and globalization on the environment is growing, creating competition among companies in various industries to produce eco-friendly goods (Guzmán and Magrini, 2021). The cosmetic industry has made quick progress in satisfying consumer demands. Antibiotic-resistant microorganisms are a serious health problem that results in 700,000 infections-related fatalities each year (Luong and Lucia, 2020). New, efficient antimicrobial agents with low toxicity, affordable production, and widespread application in numerous fields are being sought after by scientists. The World Health Organization report emphasizes the demand for environmentally friendly, sustainable products across numerous industries (Juliano *et al.,* 2019).

The word cosmetic was derived from the Greek word kosmtikos, which means ability, power, or arrangement in beautifying (Bijauliya *et al.,* 2017). Throughout the history of man, cosmetics have formed a consistent narrative as they have evolved. In the distant past (3000 BC), man used color to entice the prey he wanted to hunt, as well as to defend himself from attacks by painting his

skin and adorning his body, both for protection and to make an enemy (whether man or animal) fear him (Bijauliya *et al.,* 2017; Juliano *et al.,* 2019). In the past, cosmetics have been associated with hunting, combat, religion, and superstition; however, they are now associated with medicines (Bijauliya *et al.,* 2017). The term cosmeceuticals were first used in 1961 by Raymond Reed, a founding member of the United States (U.S) Society of Cosmetics Chemists. He used the phrase to refer to active, scientifically based cosmetics (Sharma and Paramesh, 2010; Saha, 2012).

Methodology

Formulation of Cosmetics Products from *H. crepitans* Seeds Oil

Skin cream

Five (5.0 g) of *H. crepitans* oil was mixed with 2.0 g emulsifying wax, 1.0 g of stearic acid, and 0.8 g of acetyl alcohol. The mixture was heated to melt at 70 ^{0}C and a mixture of 15 cm^3 of water, 1.6 g glycerin, and 5.0 g of sodium stearate was added with a continuous stirring. Furthermore, 0.7g sodium benzoate, 0.3 g methylparaben, and 5cm^3 propylene glycol were added to the moisture with constant stirring as well (Warra, 2017; Warra, 2019).

Hair cream

Five grams (5.0 g) of *H. crepitans* oil was mixed with 2.0 g of bee wax, 3.0 g of shear butter and coconut oil, 4.0 cm^3 of vitamin E oil, 3.0 cm^3 of paraffin oil 5.0 cm^3 of petroleum jelly, 2.0 g of lanoline were mixed and heated to 75^{o}C. Furthermore, 1.5g of glycerin, 2.0 g of camphor, and menthol were added to the mixture with constant stirring (Warra, 2017; Warra, 2019).

Bar Soap

Five grams of *H. crepitans* oil and 10.0 g of palm kernel oil were melted at 70^{o}C. Two (2.0 g) of caustic soda and kaolin was added to 50 cm^3 of distilled water with continuous stirring in a separate container. Another container with 2.0 g of soda ash and sodium sulfate was added to 25 cm^3 of water with continuous stirring. The melted oil above was added to the caustic soda solution initially prepared with constant stirring, and then the soda ash solution was also added (Warra, 2017; Warra, 2019).

Antimicrobial Test of Cosmetic Products

The antibacterial activity of skin cream, hair cream, and bar soap was determined through a susceptibility test using the agar well diffusion method as described by Muhaidat *et al*. (2015). According to this method, different concentrations of the skin cream, hair cream, and bar soap were made into 250 mg/ml, 200mg/ml, 150mg/ml, and 100mg/ml by dissolving 0.25g of the products into 1.0 cm^3 of DMSO cm^3 and oflaxacin 5 µg was used as standard control. Nutrient agar was the medium used as the growth medium for the organisms. The medium was prepared according to the Manufacturer's specifications and sterilized at 121 ^{O}C for 15 min. Twenty (20.0 cm^3) of the medium was poured into each of the sterilized Petri dishes, and allowed to cool and solidify, the sterilized medium was seeded with 0.1 cm^3 of standard inoculum of the test microbe; the inoculum was spread evenly over the surface of the medium and sterile cork borer was used to bore well on each inoculated medium; the well was filled with 0.1 cm^3 solution of the cosmetic products (250mg/ml, 200mg/ml, 150mg/ml and 100mg/ml) with standard Pasteur pipette and allowed to diffuse for 1hour at room temperature. The plates were then incubated for 24 hours at 37^{O}C, after which the medium was observed for the zone of inhibition of growth which was measured in millimeters as the diameter of growth-free zones around the bored holes using a transparent ruler.

Result and Discussion

Cosmetics from H. crepitans Oil

The oil produced from the seeds of *H. crepitans* was efficiently used for the formulation of different varieties of cosmetics products for household usage. The types of cosmetics products, quantity, colours, fragrance, and their acidity or alkalinity status are presented in Table 1.

Table 1: Cosmetic products from *H. crepitans* oil and their physical properties

S/N	Formulation	Quantity	Colour	Fragrance	pH
1	Skin cream	6	Yellow	Banana flavor	14.130±0.430
2	Hair cream	4	White	Menthol	10.813±0.050
3	Bar soap	6	White	Banana	6.870±0.130

Mean ± SEM (Standard Error of Mean)

a) b) c)

Figure 1: Cosmetics from *H. crepitans* seed oil, a) hair cream b) bar soap c) body cream

Antimicrobial Studies of Cosmetic Products

The diameter of the zone of inhibition of microbial organisms against cosmetic products formulated from extracted oil of *H. crepitans* seeds using ofloxacin was used as a standard positive control (Table 2–5).

Table 2: Zone inhibition of microbial organisms against body cream formulated from the oil of *H. crepitans* seeds.

			Concentrations	mg/ml	
Bacteria	**250**	**200**	**150**	**100**	**Oflaxacin µg**
SA	---	---	---	---	38mm
BS	---	---	---	---	24mm
EC	16mm	12mm	10mm	7mm	33mm
ST	14mm	9mm	8mm	5mm	36mm

Key: SA= *Staphylococcus aureus*, BS= *Bacillus subtilis*, EC= *Escherichia coli*, ST= *Salmonella typhi*

Table 3: Zone inhibition of microbial organisms against hair cream formulated from the oil of *H. crepitans* seeds

	Concentration mg/ml				
Bacteria	**250**	**200**	**150**	**100**	**Oflaxacin µg**
SA	21mm	14mm	13mm	12mm	38mm
BS	22mm	18mm	15mm	9mm	24mm
EC	15mm	10mm	9mm	---	33mm
ST	11mm	9mm	9mm	7mm	36mm

Key: SA= *Staphylococcus aureus*, BS= *Bacillus subtilis*, EC= *Escherichia coli*, ST= *Salmonella typhi*

Table 4: Zone inhibition of microbial organisms against bar soap formulated from the oil of *H. crepitans* seeds.

	Concentration mg/ml				
Bacteria	**250mg/ml**	**200mg/ml**	**150mg/ml**	**100mg/ml**	**Oflaxacin µg**
SA	19mm	14mm	12mm	11mm	38mm
BS	15mm	13mm	11mm	8mm	24mm
EC	14mm	---	---	---	33mm
ST	15mm	13mm	10mm	9mm	36mm

Key: SA= *Staphylococcus aureus*, BS= *Bacillus subtilis*, EC= *Escherichia coli*, ST= *Salmonella typhi*

Discussion

The quantity and physical properties including fragrance, and colour appearance of the formulated cosmetics products were presented in Table 1. Six skin creams (yellow) & and bar soap (white) and four hair creams (white) were formulated using the extracted *H. crepitans* seeds oil which was lower than the quantity of cosmetics produced by the Centre for Entrepreneurship and Development (CED) of Federal University Gusau. The difference observed was due to the large scale of production of the oil by the center and targeted quantities and end consumers (Warra, 2017). Furthermore, the fragrances of the skin cream and bar soap are banana while hair cream is menthol which is the normal fragrance used in CED (Warra, 2017). The pH values of the formulated cosmetics were also presented in Table 1. The pH of human skin is reported to be between the ranges of 4-6.5 and thus any products of good use must have a pH value greater than the normal human skin. Thus, the pH of the *H. crepitans* oil-derived cosmetics viz skin & hair creams and bar soap having pH higher than that of human skin is commendable which further suggested the qualities and applicability of the formulated products (Hair Routine, 2021).

To ensure the safety of the formulated products, cosmetic science, and industry have been searching for alternatives for synthetic products characterized by antimicrobial action. The antimicrobial properties of the formulated cosmetic products from *H. creptans* seeds oil *Staphylococcus aureus*, *Bacillus subtilis*, *Escherichia coli*, and *Salmonella typhi bacteria.* The antimicrobial activities of the cosmetic products of skin cream, hair cream, and bar soap is shown in Tables 2-4. The skin cream (Table 2) has zone inhibition in all the tested organisms in a concentration-dependent (250-100mg/cm^3) pattern except *S. aureus* and *B. subtilis* which do

not have any zone inhibition. The same concentration-dependent effects of zone inhibitions were observed in hair cream and bar soap. However, the hair cream and bar soap have no zone inhibitions at least a concentration of 100mg/cm^3 (Table 3) and 200-100mg/cm^3 (Table 4) against *Escherichia coli.* The antimicrobial activity of the formulated cosmetic products against the tested organisms could further provide ground for domestic usage. As suggested by Sanabria-Rios (2021) these properties exhibited by the formulated products may result from the presence of saturated and unsaturated fatty acids.

Conclusion

In this work, the oil from *H. crepitans* previously extracted was used for the formulation of three cosmetic products namely skin cream, hair, cream, and bar soap for domestic use. In addition, the physical properties such as colour, fragrance, pH of the formulated products were evaluated. To ensure the safe use of the formulated products, an antimicrobial test was carried out on the formulated products which further enhanced the applicability of these cosmetics for domestic usage. Thus, the results of this research have validated the claim of *H. crepitans* seeds oil as a potential active ingredient in the cosmetic industry.

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Citation: Formulation and Antimicrobial Activities of the Selected Cosmetic Products from *Hura crepitans* Seeds Oil. ***Sokoto Journal of Medical Laboratory Science*; 8(4): 100 – 104**. https://dx.doi.org/10.4314/sokjmls.v8i4.12